Sediment Control

Install perimeter controls

Temporary Diversion Dikes, Earth Dikes, and Interceptor Dikes

Construction Site Storm Water Runoff Control

Description

Diversion dikes can be used to contain storm water onsite

Earthen perimeter controls usually consist of a dike or a combination dike and channel constructed along the perimeter of a disturbed site. Simply defined, an earthen perimeter control is a ridge of compacted soil, often accompanied by a ditch or swale with a vegetated lining, located at the top or base of a sloping disturbed area. Depending on their location and the topography of the landscape, earthen perimeter controls can achieve one of two main goals.

Located on the upslope side of a site, earthen perimeter controls help to prevent surface runoff from entering a disturbed construction site. An earthen structure located upslope can improve working conditions on a construction site by preventing an increase in the total amount of sheet flow runoff traveling across the disturbed area and thereby lessen erosion on the site.

Alternatively, earthen perimeter control structures can be located on the downslope side of a site to divert sediment-laden runoff created onsite to onsite sediment trapping devices, preventing soil loss from the disturbed area.

These control practices can be referred to by a number of terms, including temporary diversion dikes, earth dikes, or interceptor dikes. Generally speaking, however, all earthen perimeter controls are constructed in a similar fashion with a similar objective—to control the velocity and/or route of sediment-laden storm water runoff.

Applicability

Temporary diversion dikes are applicable where it is desirable to divert flows away from disturbed areas such as cut or fill slopes and to divert runoff to a stabilized outlet (EPA, 1992). The dikes can be erected at the top of a sloping area or in the middle of a slope to divert storm water runoff around a disturbed construction site. In this way, earth dikes can be used to reduce the length of the slope across which runoff will travel, thereby reducing the erosion potential of the flow. If placed at the bottom of a sloping disturbed area, diversion dikes can divert flow to a sediment trapping device. Temporary diversion dikes are usually appropriate for drainage basins smaller than 5 acres, but with modifications they can be capable of servicing areas as large as 10 acres. With regular maintenance, earthen diversion dikes have a useful life span of approximately 18 months.

To prevent storm water runoff from entering a site, earthen perimeter controls can be used to divert runoff from areas upslope around the disturbed construction site. This is accomplished by constructing a continuous, compacted earthen mound along the upslope perimeter of the site. As an additional control measure, a shallow ditch can accompany the earthen mound.

Siting and Design Considerations

The siting of earthen perimeter controls depends on the topography of the area surrounding a specific construction site and on whether the goal is to prevent sediment-laden runoff from entering the site or to keep storm water runoff from leaving the site. When determining the appropriate size and design of earthen perimeter controls, the shape of the surrounding landscape and drainage patterns should be considered. Also, the amount of runoff to be diverted, the velocity of runoff in the diversion, and the erodibility of soils on the slope and within the diversion channel or swale are essential design considerations (WSDE, 1992).

Diversion dikes should be constructed and fully stabilized prior to commencement of major land disturbance. This will maximize the effectiveness of the diversion measure as an erosion and sediment control device.

The top of earthen perimeter controls designed as temporary flow diversion measures should be at least 2 feet wide. Bottom width at ground level is typically 6 feet. The minimum height for earthen dikes should be 18 inches, with side slopes no steeper than 2:1. For points where vehicles will cross the dike, the slope should be no steeper than 3:1 and the mound should be constructed of gravel rather than soil. This will prolong the life of the dike and increase effectiveness at the point of vehicle crossing.

If a channel is excavated along the dike, its shape can be parabolic, trapezoidal, or V-shaped. Prior to excavation or mound building, all trees, brush, stumps and other objects in the path of the diversion structure should be removed and the base of the dike should be tilled before laying the fill. The maximum design flow velocity should range from 1.5 to 5.0 feet per second, depending on the vegetative cover and soil texture.

Most earthen perimeter structures are designed for short-term, temporary use. If the expected life span of the diversion structure is greater than 15 days, it is strongly recommended that both the earthen dike and the accompanying ditch be seeded with vegetation immediately after construction. This will increase the stability of the perimeter control and can decrease the need for frequent repairs and maintenance.

Limitations

Earth dikes are an effective means of diverting sediment-laden storm water runoff around a disturbed area. However, the concentrated runoff in the channel or ditch has increased erosion potential. To alleviate this erosion capability, diversion dikes must be directed to sediment trapping devices, where erosion sediment can settle out of the runoff before being discharged to surface waters. Examples of appropriate sediment trapping devices that might be used in conjunction with temporary diversion structures include a sediment basin, a sediment chamber/filter, or any other structure designed to allow sediment to be collected for proper disposal.

If a diversion dike crosses a vehicle roadway or entrance, its effectiveness can be reduced. Wherever possible, diversion dikes should be designed to avoid crossing vehicle pathways.

Maintenance Considerations

Earthen diversion dikes should be inspected after each rainfall to ensure continued effectiveness. The dike should be maintained at the original height, and any decrease in height due to settling or erosion should be repaired immediately. To remain effective, earth dikes must be compacted at all times. Regardless of rainfall frequency, dikes should be inspected at least once every 2 weeks for evidence of erosion or deterioration.

Effectiveness

When properly placed and maintained, earth dikes used as temporary diversions are effective for controlling the velocity and direction of storm water runoff. Used by themselves, they do not have any pollutant removal capability. Diversion dikes must be used in combination with an appropriate sediment trapping device at the outfall of the diversion channel.

Cost Considerations

The cost of constructing an earthen dike can be broken down into two components: (1) site preparation, including excavation, placement and compacting of fill, and grading, and (2) site development, including topsoiling and seeding for vegetative cover. The Southeastern Wisconsin Regional Planning Commission (1991) estimated the total cost of site preparation to be $46.33 to $124.81 for a 100-foot dike with 1.5-foot-deep, 3:1 side slopes. The cost of site development was estimated at $115.52 to $375.44. The total cost was between $162 and $500.

References

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Wind Fences and Sand Fences

Construction Site Storm Water Runoff Control

Description

A Sand fences are barriers of small, evenly spaced wooden slats or fabric erected to reduce wind velocity and to trap blowing sand. They can be used effectively as perimeter controls around open construction sites to reduce the off-site movement of fine sediments transported by wind. They also prevent off-site damage to roads, streams, and adjacent properties. The spaces between fence slats allow wind and sediment to pass through but reduces the wind velocity, which causes sediment deposition along the fence.

Sand fences are used to trap blowing sand and to reduce offsite movement of sand particles

Applicability

Wind fences are applicable to areas with a preponderance of loose, fine-textured soils that can be transported off-site by high winds. They are especially advantageous for construction sites with large areas of cleared land or in arid regions where blowing sand and dust are especially problematic. Shorefront development sites also benefit from using wind fences because they promote the formation of frontal dunes.

Siting and Design Considerations

Effective trapping of sediment and reduction of wind velocity occurs only when the fence is erected perpendicular to the prevailing wind. Although wind fences have been shown effective up to 22.5 degrees from perpendicular, they should be erected as close to perpendicular to the movement of wind as possible (Smolen et al., 1988). Multiple fences can be erected to increase sediment-trapping efficiency, depending on the degree of protection desired. Linear rows of fence 2 to 4 feet high and spaced 20 to 40 feet apart can be installed. When used on shoreline beaches, wind fences should be installed well away from the incoming tide.

Limitations

A wind fence does not control sediment carried in storm water runoff. Wind fences should be installed in conjunction with other sediment and erosion control measures that capture sediment from runoff.

Maintenance Considerations

Wind fences require periodic inspection to ensure that there are no breaks or gaps. Repairs should be made immediately. Sand and sediment should be cleaned from the fence area periodically to prevent their mobilization by storm water runoff.

Effectiveness

Wind fences are very effective for promoting dune formation along shoreline areas, but are not adequate as a primary dust control or sediment-trapping measure for perimeters of construction sites. They should be used only in conjunction with other erosion and sediment control practices.

Cost Considerations

Wind and sand fences are relatively inexpensive to purchase, install, and maintain because they are small, easy to transport, lightweight, and constructed of low-cost materials.

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Brush Barrier

Construction Site Storm Water Runoff Control

Description


Brush barriers trap sediment and remove pollutants from storm water

Brush barriers are perimeter sediment control structures used to prevent soil in storm water runoff from leaving a construction site. Brush barriers are constructed of material such as small tree branches, root mats, stone, or other debris left over from site clearing and grubbing. In some configurations, brush barriers are covered with a filter cloth to stabilize the structure and improve barrier efficiency.

Applicability

Brush barriers are applicable to sites where there is enough material from clearing and grubbing to form a sufficient mound of debris along the perimeter of an area. The drainage area for brush barriers must be no greater than 0.25 acre per 100 feet of barrier length. In addition, the drainage slope leading down to a brush barrier must be no greater than 2:1 and no longer than 100 feet. Brush barriers have limited usefulness because they are constructed of materials that decompose.

Siting and Design Considerations

A brush barrier can be constructed using only cleared material from a site, but it is recommended that the mound be covered with a filter fabric barrier to hold the material in place and increase sediment barrier efficiency. Whether a filter fabric cover is used or not, the barrier mound should be at least 3 feet high and 5 feet wide at its base. Material with a diameter larger than 6 inches should not be used, as this material may be too bulky and create void spaces where sediment and runoff will flow through the barrier.

The edge of the filter fabric cover should be buried in a trench 4 inches deep and 6 inches wide on the drainage side of the barrier. This is done to secure the fabric and create a barrier to sediment while allowing storm water to pass through the water-permeable filter fabric. The filter fabric should be extended just over the peak of the brush mound and secured on the down-slope edge of the fabric by fastening it to twine or small-diameter rope that is staked securely.

Limitations

Brush barriers are an effective storm water runoff control only when the contributing flow has a slow velocity. Brush barriers are therefore not appropriate for high-velocity flow areas. A large amount of material is needed to construct a useful brush barrier. For sites with little material from clearing, alternative perimeter controls such as a fabric silt fence may be more appropriate. Although brush barriers provide temporary storage for large amounts of cleared material from a site, this material will ultimately have to be removed from the site after construction activities have ceased and the area reaches final stabilization.

Maintenance Considerations

Brush barriers should be inspected after each significant rainfall event to ensure continued effectiveness. If channels form through void spaces in the barrier, the barrier should be reconstructed to eliminate the channels. Accumulated sediment should be removed from the uphill side of the barrier when sediment height reaches between 1/3 and 1/2 the height of the barrier. When the entire site has reached final stabilization, the brush barrier should be removed and disposed of properly.

Effectiveness

Brush barriers can be effective at reducing off-site sediment transport, and their effectiveness is greatly increased with the use of a fabric cover on the up-slope side of the brush barrier.

Cost Considerations

Creating brush barriers can range in cost from $390 to $620, depending upon the equipment used, vegetation type (heavy or light), fuel price, personnel, amount of filter fabric needed (if used), and the number of hours to perform the task. A common filter fabric, geotextile, can range in cost from $0.50 to $10.00/square yard, depending upon the type of geotextile used.

References

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Straw Wattles. 2000. *Photos: Mine1*. [http://www.strawwattles.com/photos/mine1.jpg]. Accessed January 2001.

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Silt Fence

Construction Site Storm Water Runoff Control

Description

Silt fences prevent the offsite transport of sediment

Silt fences are used as temporary perimeter controls around sites where there will be soil disturbance due to construction activities. They consist of a length of filter fabric stretched between anchoring posts spaced at regular intervals along the site perimeter. The filter fabric should be entrenched in the ground between the support posts. When installed correctly and inspected frequently, silt fences can be an effective barrier to sediment leaving the site in storm water runoff.

Applicability

Silt fences are generally applicable to construction sites with relatively small drainage areas. They are appropriate in areas where runoff will be occurring as low-level shallow flow, not exceeding 0.5 cfs. The drainage area for silt fences generally should not exceed 0.25 acre per 100-foot fence length. Slope length above the fence should not exceed 100 feet (NAHB, 1995).

Siting and Design Considerations

Material for silt fences should be a pervious sheet of synthetic fabric such as polypropylene, nylon, polyester, or polyethylene yarn, chosen based on minimum synthetic fabric requirements, as shown in Table 1.

Table 1. Minimum requirements for silt fence construction (Sources: USEPA, 1992; VDCR, 1995)

Physical Property	Requirements
Filtering Efficiency	75–85% (minimum): highly dependent on local conditions
Tensile Strength at 20% (maximum) Elongation	Standard Strength: 30 lbs/linear inch (minimum) Extra Strength: 50 lbs/linear inch (minimum)
Ultraviolet Radiation	90% (minimum)
Slurry Flow Rate	0.3 gal/ft2/min (minimum)

If a standard strength fabric is used, it can be reinforced with wire mesh behind the filter fabric. This can increase the effective life of the fence. In any case, the maximum life expectancy for synthetic fabric silt fences is approximately 6 months, depending on the amount of rainfall and runoff for a given area. Burlap fences have a much shorter useful life span, usually only up to 2 months.

Stakes used to anchor the filter fabric should be either wooden or metal. Wooden stakes should be at least 5 feet long and have a minimum diameter of 2 inches if a hardwood such as oak is used. Softer woods such as pine should be at least 4 inches in diameter. When using metal post in place of wooden stakes, they should have a minimum weight of 1.00 to 1.33 lb/linear foot. If metal posts are used, attachment points are needed for fastening the filter fabric using wire ties.

A silt fence should be erected in a continuous fashion from a single roll of fabric to eliminate unwanted gaps in the fence. If a continuous roll of fabric is not available, the fabric should overlap from both directions only at stakes or posts with a minimum overlap of 6 inches. A trench should be excavated to bury the bottom of the fabric fence at least 6 inches below the ground surface. This will help prevent gaps from forming near the ground surface that would render the fencing useless as a sediment barrier.

The height of the fence posts should be between 16 and 34 inches above the original ground surface. If standard strength fabric is used in combination with wire mesh, the posts should be spaced no more than 10 feet apart. If extra-strength fabric is used without wire mesh reinforcement, the support posts should be spaced no more than 6 feet apart (VDCR, 1995).

The fence should be designed to withstand the runoff from a 10-year peak storm event, and once installed should remain in place until all areas up-slope have been permanently stabilized by vegetation or other means.

Limitations

Silt fences should not be installed along areas where rocks or other hard surfaces will prevent uniform anchoring of fence posts and entrenching of the filter fabric. This will greatly reduce the effectiveness of silt fencing and can create runoff channels leading off site. Silt fences are not suitable for areas where large amounts of concentrated runoff are likely. In addition, open areas where wind velocity is high may present a maintenance challenge, as high winds may accelerate deterioration of the filter fabric. Silt fences should not be installed across streams, ditches, or waterways (Smolen et al., 1988).

When the pores of the fence fabric become clogged with sediment, pools of water are likely to form on the uphill side of fence. Siting and design of the silt fence should account for this and care should be taken to avoid unnecessary diversion of storm water from these pools that might cause further erosion damage.

Maintenance Considerations

Silt fences should be inspected regularly and frequently as well as after each rainfall event to ensure that they are intact and that there are no gaps at the fence-ground interface or tears along the length of the fence. If gaps or tears are found, they should be repaired or the fabric should be replaced immediately. Accumulated sediments should be removed from the fence base when the sediment reaches one-third to one-half the height of the fence. Sediment removal should occur more frequently if accumulated sediment is creating noticeable strain on the fabric and there is the possibility of the fence failing from a sudden storm event. When the silt fence is removed, the accumulated sediment also should be removed.

Effectiveness

USEPA (1993) reports the following effectiveness ranges for silt fences constructed of filter fabric that are properly installed and well maintained: average total suspended solids removal of 70 percent, sand removal of 80 to 90 percent, silt-loam removal of 50 to 80 percent, and silt-clay-loam removal of 0 to 20 percent. Removal rates are highly dependent on local conditions and installation.

Cost Considerations

Installation costs for silt fences are approximately $6.00 per linear foot (USEPA, 1992). SWRPC estimates unit costs between $2.30 and $4.50 per linear foot (SWRPC, 1991).

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